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ABSTRACT

This review of the research literature describes and discusses functional/information literacy in the age of computers and the resulting "information explosion," together with means by which students can become competent information users in the future and be enabled to lead productive, meaningful lives. Defined as comprising library skills and computer literacy, information literacy is discussed in relationship to school media centers, which have become key places for integrating skills and resources with subjects across the curriculum, and allowing students to develop proficiency in inquiry. This study summarizes information technologies useful in schools and reviews international information literacy programs to provide insights into ways that administrators, teachers, and library media specialists can work together to prepare students to meet the challenges of the information age. Included in the discussion are (1) definitions and characteristics of information literacy; (2) the library media center as information center; (3) integrating information skills with the curriculum; (4) information technologies in schools; and (5) means of achieving information literacy. It is concluded that competent use of information can offer beneficial results to society-at-large, and that, conversely, information illiteracy can cause harm to individuals and to society. (75 references) (CGD)

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ERIC Clearinghouse on Information Resources
School of Education
School of Information Studies
Syracuse University
Syracuse, New York
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Carol Collier Kuhlthau

ERIC Clearinghouse on Information Resources

Syracuse University, Syracuse, New York
December 1987

Carol Collier Kuhlthau is Director of the Educational Media Services Program in the School of Communication, Information, and Library Studies at Rutgers, the State University, New Brunswick, New Jersey.

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PREFACE

Enabling school children to become functionally literate in the age of computers and the resulting "information explosion" has become a goal of education internationally. Such literacy is deemed essential to leading productive, meaningful lives.

Defined as comprising library skills and computer literacy, information literacy requires skills necessary for the interpretation and use of information. Library media centers are excellent sites for integrating skills and resources with subjects across the curriculum, allowing students to develop proficiency in inquiry. This study summarizes information technologies useful in schools and reviews international information-literacy programs to provide insights into ways administrators, teachers, and library media specialists can work together to prepare students to meet the challenges of the information age.

INTRODUCTION

Living in an "age of information" means confronting changes in every aspect of our lives (Masuda, 1980; Naisbett, 1982; Reich, 1983; Seidel and Rubin, 1975), and most of these aspects involve literacy. At one time literacy was defined as the ability to read at a fifth-grade level (Kozol, 1985). Today, literacy is understood to combine the ability to function in a society that has grown increasingly complex, in part because of expanding computer capabilities. In recent years, reports have documented alarming increases in the numbers of United States citizens who are "functionally illiterate"—i.e., unable to manage the information necessary for leading productive, meaningful lives.

Internationally, educators have begun research and development of means to combat the problem of functional illiteracy in the information age. Administrators, teachers, and library media specialists are working together to develop strategies for enabling school children to gain competency in using information. School media centers have become key places where skills and resources are integrated to provide students access to information about subjects across the curriculum. Such access is essential if functional literacy is to become a widespread reality.

Computers transform traditional means of producing, storing, organizing, and gaining access to information. Sophisticated information-processing skills have become the norm in many work environments. Today's adult needs the ability to comprehend and complete complicated forms relating to all aspects of everyday life. "Real-time" information-flow through mass media affects the political process by bombarding citizens with events and opinions which must be evaluated carefully in order to make informed decisions. Across society, adults who cannot read and write are in a much more precarious position than they would have been in the more simple industrial, or agricultural, environments of the past.

Public education's inadequate responses to the dynamic changes taking place in society were brought to national attention in the 1983 report, *A Nation at Risk* (1983). Educators gained awareness of children's need to be able to manage information. As a result, several major developments in education have occurred. These developments were categorized by the American Federation of Information-Processing Societies (AFIPS) as belonging to three general groups: (1) acknowledgement of the need for a more integrated approach to curriculum-development; (2) recognition that larger problems lie beyond the immediate one of providing students basic computer literacy; and (3) adoption of a holistic approach to education, centered around fundamental problem-solving techniques. ("Information and Computing," 1986, p. 155-183)

At the heart of all of these developments is information literacy. Defining the term, and its requisite skills, is a necessary first step before considering means by which it may be achieved.

INFORMATION LITERACY: DEFINITIONS

What does it mean to be literate in an information society? Information literacy is closely tied to functional literacy. It involves the ability to read and to use information essential for everyday life. It also involves recognizing an information need and seeking information to make informed decisions. Information literacy requires the abilities to manage complex masses of information generated by computers and mass media, and to learn throughout life as technical and social changes demand new skills and knowledge.

A working definition of information literacy has been proposed by Martin Tessner (Breivik, 1985): "Information literacy is the ability to effectively access and evaluate information for a given need." The concept of information literacy incorporates notions about what a literate person will be able to do. The literate person will be able to effectively access and evaluate information for a given need. This definition not only identifies the skills of accessing and evaluating but also specifies the application of the skills (i.e., what the skills will be used for). The purpose of information literacy is to meet an information need. Information literacy enables a person to use information for making decisions and solving problems.

Literacy involves process skills which are applied for a particular purpose. Reading and writing are skills which are used for understanding, learning, and communicating. Literacy skills provide the tools for learning concepts and communicating ideas. Information skills are process skills which are applied in response to a need for information to answer a question or solve a problem. Thus, information literacy is connected to content and applied for a purpose (Biggs, 1980).

In defining information literacy, one must delineate general terms (Breivik, 1985). Information literacy is not only a knowledge of resources. It is not solely dependent on the library as the only source of information. It is not merely finding information, but is also understanding information.

While information literacy is closely akin to library literacy, important differences between information skills and traditional library skills have emerged.

Location and Interpretation Skills

Library skills have two components: location skills and interpretation skills (Kuhlthau, 1981). Traditionally, library media specialists have been associated with instruction of location skills, but they have been more involved in interpretation skills than is commonly acknowledged. Location skills involve a knowledge of the sources and tools in libraries. The ability to find specific information within sources is also a location skill. An example of a location skill is using the card catalog to locate a book on African animals and then using the index within the book to find information on tigers. Location skills stop short of using the information once it is found.

Interpretation skills involve how the information is used after it is located. Thinking about information, seeking further information based on expand-

ing thoughts, and preparing to present information to others incorporate a sequence of interpretation skills. Recalling, summarizing, paraphrasing, and extending are interpretation skills. An example of an interpretation skill occurs when, after a student has located the information on tigers in the book, he or she reads the section, then closes the text and writes about what is recalled as important and interesting. Merely copying word for word from a text is not interpretation. Interpretation involves meaningfully processing information and making it one's own. Another example occurs after children view a film, when they discuss how the content relates to their own experiences. Critical thinking is involved in interpretation.

A Broader View of Library Skills

Mounting evidence indicates that when location skills are taught in a narrow context they simply do not take (Buddy, 1982; Kuhlthau, 1981; Mellon, 1986). Library instruction which is limited to locating a particular source in a particular library has little transferability when students move on to other libraries and to actual situations of information need. The terms "library anxiety" and "research shock" have been coined to describe students' plight in new library situations.

The broader view of location skills offers students an understanding of the concept that information is organized by a system which provides access to a particular source and a specific bit of information. The library media center becomes a laboratory for learning essential components of one information system. Through constant applied use in response to a clear need for information, students learn location skills which become ingrained as information habits.

For the person using libraries, locating and interpreting are naturally connected and cannot be artificially divided into separate activities. Recognition of the interplay of locating and interpreting in the process of using information promotes a broader view of library skills. The concept paper by Mancall, Aaron and Walker, "Educating Students to Think: The Role of the School Library Media Program," provides a rationale for incorporating the development of critical thinking into library instruction: "Information management skills instruction...must be broader and more process-oriented. Focus must go beyond location skills and 'correct answers' and move to strategies that will help students to develop insight and faculty in structuring successful approaches to solving information needs" (1986, p. 23).

Library instruction that guides students through levels of information, need to solve a problem, or to shape a topic enables them to use information for learning. The process approach to library instruction presents a search as a series of stages in which thoughts about a problem or topic are changing and emerging as information is gathered (Kuhlthau, 1983). Recent studies show that an awareness of the information search process provides students with realistic expectations which they bring to other searching situations (Kuhlthau, in press).

In some cases teaching students how to search for information may actually hinder development of information skills, if students are effortlessly guid-

ed through tasks without ever having to reflect on their aims and purposes and how they might best be achieved. A British Library research review on "Educating Information Users in Schools" reports on projects and conferences sponsored by the Research and Development Department which have established the need for information literacy programs (Irving, 1983). Getting students to become intellectually engaged and to participate with a sense of ownership is the goal of the broader view of library instruction.

A Broader View of Computer Literacy

In the information age, computer literacy is an essential component of information literacy. Computer literacy is an understanding of what computer hardware and software can do. Information literacy goes beyond computer literacy by raising the level of awareness of the knowledge explosion, and how computers can help identify, access, and obtain data and documents needed for problem-solving and decision making (Horton, 1983).

Educators initially responded to the proliferation of computers in the work place and the home by teaching students to operate and program computers. This instruction is commonly referred to as computer literacy. Teachers were rushed through crash courses on computer programming in order to teach the new computer courses. This narrow view of the skills needed for the information age has proved totally inadequate. Skill in operating and programming computers does not prepare children for the range of abilities required in our society ("Information and Computing," p. 155).

Recognition that the approach to computer literacy has been inadequate goes hand-in-hand with the recognition that a narrow view of library skills is not effective. Information skills require a broader view of both computer use and library use. Information skills are applied to the library and the computer for a particular purpose.

Database searching is being made available in many secondary school library media centers and in some elementary schools. Using the computer to search for sources for solving a particular problem is one of the most practical ways to apply computer skills. Databases provide the link between computer skills and library skills and offer an opportunity for students to acquire and practice skills which will serve them well in learning throughout their lives. Some of the skills students may acquire in database searching are developing search strategy, choosing appropriate databases, and assessing retrieved information (Tenopir, 1986).

Montgomery County (Maryland) Public Schools designed a guide which emphasizes the computer as a teaching tool with activities that teach students how to use the computer to store, access, and manipulate data (*Microcomputer Utilization*, 1985). This is a K-12 scope and sequence with appropriate grade levels for addressing information retrieval skills. Online searching is included as one of the activities for 10-12 grade research papers as well as word processing. The use of print resources is combined with resources accessed through the computer.

The shift in computer instruction from orientation to operating computers to the application and use of the computer parallels the shift in library instruction from orientation to sources to the interpretation and use of information. Information skills combine a broader view of library skills with computer skills to develop competencies for the information age.

CHARACTERISTICS OF INFORMATION LITERACY

The acquisition of information literacy involves mastery of certain skills with particular characteristics. These characteristics may be described as follows: (1) integrating knowledge of tools and resources with skills (such as the ability to plan a research strategy, or to evaluate information); (2) depending upon acquisition of such attitudes as persistence, attention to detail, and skepticism; (3) time- and labor-intensive; (4) need-driven; and (5) existing independently of, but relating to, literacy and computer literacy (Breivik, 1985, p. 723).

The following analysis of each characteristic further defines its relation to information literacy.

Skills and Knowledge

The skills and knowledge aspects of information literacy are closely related to the location and interpretation components of library skills. Information literacy begins with a knowledge of the sources of information and the tools, such as indexes, to access information. The skills required are strategies and techniques which may be applied to provide access when information is needed. Ability to evaluate information and determine relevance are also information skills. The skills and knowledge comprise an integrated set of information abilities.

Information technology has introduced tools such as electronic files for storing and sharing information, electronic mail systems for exchange of messages, word processing for writing, and spreadsheets for presenting numerical information. The tools of technology require new skills which are defined by what a person will need to know and be able to do to take advantage of information technology (Johnston, 1985). For example, the user will need to find and manipulate texts through computer searching and retrieval. Skills in operating a computer and ability to scan a text are necessary competencies. Information handling skills are companion competencies to computer-operating skills.

Analysis of what users need to know reveals a complex combination of competencies, including knowledge of sources and tools, skills in locating sources and operating equipment, techniques for interpreting and using information, and strategies for applying capabilities to actual situations in which information is needed.

A model statement of general and terminal objectives of information literacy skills has been prepared by an Association of College and Research Libraries/Bibliographic Instruction Section (ACRL/BIS) task force ("Model Statement," 1987). The general objectives are listed under four categories:

- How information is identified and defined by experts.
  The user understands how information is defined by experts, and recognizes how that knowledge can help determine the direction of his/her search for specific information.

- How information sources are structured.
  The user understands the importance of the organizational content, bibliographic structure, function, and use of information sources.

- How information sources are intellectually accessed by users.
  The user can identify useful information from information sources or information systems.

- How information sources are physically organized and accessed.
  The user understands the way collections of information sources are physically organized and accessed.

In order to plan instructional programs for elementary and secondary students, it is necessary to know what will be expected of them when they move on into the work world and further academic study. It is also necessary to know what students already know about information use. What sources of information do students now use and how effective is their use? The Mancall/Drott studies addressed the problem of how to measure students' information-seeking behaviors in order to design library instruction, services, and collections that are based on actual usage patterns (Mancall and Drott, 1983). The studies provide a model for measuring student information use at a district level to plan instruction which matches the particular needs of a community.

Attitudes

The next characteristic of information literacy/skills presented in the definition relates to attitudes. Attitudes such as persistence, attention to detail, and skepticism (or, caution in accepting information) are learned over a period of time with experience. In order to internalize an attitude, sufficient opportunities for practice must be provided. A sequence of instruction is necessary to learn attitudes which will transfer to other situations of information need.

The affective domain has been found to have a strong influence on behavior and must be considered along with the cognitive and psychomotor domain in planning information instruction. Attitudes are established through three levels of learning: orientation, interaction, and internalization (Jakobovits, 1987). Orientation alone cannot be depended on to establish or change attitudes. Interaction and internalization are essential to fix attitudes for the long term.

Studies of junior high- and high-school students show that library instruction had a significant effect on library use and library/librarian attitudes (Schon, 1985a, 1985b). A motivational library treatment was used which took place during an eight-week period.

Attitudes related to information literacy need to be made part of an instructional program. The perception that persistence is rewarded can only be learned through first hand experience. Attention to detail and caution in accepting information are similarly internalized through repeated contact with situations in which the attitude has been reinforced.

Time and Labor Intensive

One of the most important aspects of information literacy is an understanding of the amount of time and work involved in information seeking and use. A realistic sense of time and labor and an ability to make the most efficient use of both is learned through experience and self-awareness. For example, high school students often say they are procrastinating at the beginning of a research project, placing a negative connotation on the early stages of a search when thoughts are formulating and new information is being assimilated. This lack of awareness of the process of a search often gets in the way of productive work. A more positive approach is to expect to be confused and unclear and recognize the need for reading and mulling at the beginning of a search. The strategy of relaxing, reading, and reflecting is more productive at this time.

The process of gathering and applying information to an issue or problem takes place in a series of stages over an extended period of time. An understanding grows that information gathering and use are not linear processes addressing a single question, but rather complicated processes in which questions are continually changing and evolving as new information is collected and thought about. A six-stage model of the information search process has been developed which identifies feelings students are likely to experience along with strategies and thinking that can lead them through a productive search (Kuhlthau, 1985a). The stages are: (1) initiating a research assignment; (2) selecting a topic; (3) exploring information; (4) forming a focus; (5) collecting information; and (6) preparing to present. Using a timeline to describe the search process helps students to understand the time and effort involved in an extensive search and to plan work accordingly. Guidance in each step of the search process is an important element in an information skills curriculum. Thinking and reflecting about the process, apart from the content, is necessary to internalize the stages in order to transfer skills to other libraries and other situations of information need (Kuhlthau, 1985b).

Need Driven

At the core of information literacy is the ability to recognize a need for information. The person must become aware of problems and questions which require information, and must approach information seeking and use as problem-solving activities. Too frequently library assignments are empty exercises for which neither the student nor the teacher has much sense of purpose. Assignments must be designed to create a personally felt information need.

One of the trends in education identified by The American Federation of Information Processing Societies Secondary Education Project Committee is to take a holistic approach centered around problem solving ("Information and Computing," 1986, p. 156). An emerging theory in library instruction reveals a similar trend. Library instruction that guides students through the levels of information needed to solve a problem or to shape a topic

enables them to use information for learning. Instruction that helps them develop a realistic perception of an information system prepares them to be more successful searchers. They are preparing to use information in actual situations of information need and to transfer library skills to other systems (Kuhlthau, 1987).

Sense-making is another way of looking at information skills (Cleaver, 1987). Students learn to formulate questions which lead to information that they can use to form new understandings. Their questions need to be expanded to include what they already know and what they expect to find out. Dervin and her colleagues (1986) suggest a sense-making model which involves three elements: (1) the situation—an occurrence, or lack of sense, that raises questions; (2) the gap, which might be termed the questions, or questioning behavior; and (3) the use that is made of the answer (p. 507).

Distinct, But Relevant, to Literacy and Computer Literacy

Literacy, the ability to read and write, is the foundation on which information skills are built. Basic reading ability is essential to information literacy as information skills require reading skills. Computer literacy is also relevant to information literacy. Knowing how to operate a computer and knowing some of the concepts behind programming provide a good basis for information skills.

Information literacy goes beyond an ability to read and being acquainted with computers. Information skills prepare the child to meet the particular demands of the information age. Problem-solving, decision-making, critical thinking, information gathering, and sense-making are abilities related to information literacy. These skills must be taught in addition to basic literacy and computer literacy for functioning in an information environment (Demo, 1986).

THE LIBRARY MEDIA CENTER AS INFORMATION CENTER

Education is changing from the assembly-line environment of the industrial age offered by textbook teaching to the information-rich environment of the information age offered by access to a wide range of resources. In response to this change the media center becomes the information center of the school, located at the core of the instructional program. The concept that the media center is an extension of the classroom providing resources for learning certainly is not a new one. But the pervading philosophy and current trends in education are completely compatible with this concept of the media center. It is an idea whose time has come.

The media center has expanded to meet the information needs of the school. Library media specialists have been preparing for the information age by bringing computers into the media center and by becoming competent in the new technology ("SLJ Special Section," 1984; Troutner, 1983; Woolls and Loertscher, 1986). In the media center computers have been applied for specific purposes. Circulation systems have been computerized, collections have been put into databases for students and faculty to access through terminals, and online database services such as Dialog and Dow Jones have been made available in many high schools and, in some instances, elementary schools. Computer-assisted instruction has been added to the other categories of software in audiovisual collections. Word processing is available for students on a regular basis in many media centers. As the media center expands to meet the information needs of the school, it becomes the natural place for information skills to be learned and practiced.

Media center facilities need to be planned and renovated with an eye to the future (Lamkin, 1986). As information technology continues to evolve and improve, the facility accommodating technology needs to be able to adapt in response to these changes. Continual updating and adaptation are necessary in providing a media center facility which responds to the needs of the information age. Administrative commitment and support are essential for providing facilities to enable the media center to function as an effective information center for all areas of the curriculum.

Staffing has been found to be the critical component for the media center to function as an information center for classroom instruction. In a review of research, Gerald Hodges (1986) concluded that "the frequency with which the school library media specialist assumes an active role in curriculum and instruction is directly related to the size of the media staff." A recent study of the library media services in public schools appearing on the U.S. Department of Education's 1986 list of exemplary elementary schools found that there seems to be a threshold at which the library media program begins to pay the kinds of dividends expected from the investment made in it (Loertscher, et al., 1987). This threshold is a staff consisting of a full-time professional and a full-time clerical person. Having a fine facility stocked with ample materials and equipment is essential, but without the critical staffing component, services suffer and the impact on education is drastically

lowered. The heavy warehousing function of an information center consumes an inadequate staff in clerical activities.

Hawaii is the only state in the United States with a library staffed by a trained librarian in every public school (Bard, 1983). Leadership has been provided by the Director of School Library Services for the development and articulation of the state's program. Placement of the school library services program under the Office of Instructional Services in 1977 rather than under the State Librarian has resulted in increased emphasis on library instruction in elementary and secondary schools and in the integration of this instruction into the regular school curriculum. Professional development and training are provided for library media specialists. Communication to gain administrative support is continually taking place.

Considering the current concerns for quality in education it would make sense for administrators to take a long look at the library media center. Administrators would do well to explore what contributions the media center can make toward addressing instructional goals and objectives. Media centers as access points to most information in schools deserve more attention when considering how to educate children for the demands of the information age (Breivik, 1987; Haycock, 1985).

INTEGRATING INFORMATION SKILLS WITH THE CURRICULUM

Information skills enable a person to continue to learn throughout his or her life. Information skills are not the responsibility of the library media specialist, exclusive of the teachers and the instructional program of the school. To the contrary, information skills are the mutual responsibility of teachers and library media specialists and must be infused into instruction across the curriculum (Irving, 1985). The skills applied to learning a discipline need to be taught along with the facts of the subject. No longer can schooling be expected to supply students with all of the facts they will need to know throughout their lives. They will need to learn how to learn within each discipline in the curriculum. They will need to know how to identify a need for information; to locate, select, and gather relevant information; and to apply the information to resolve an issue under question. Information skills are learned through application and practice within the areas of the curriculum.

The concept behind integrating resources into the curriculum is resource-based learning as opposed to textbook-based learning (Beswick, 1977). Resource-based learning uses the resources of the media center to access information for classroom learning. Cooperative planning is an essential component of resource-based teaching. At the planning stage the library media specialist has the dual role of recommending resources to be used in instruction as well as identifying appropriate points to infuse specific information skills. Emphasis is placed on teaching students the information skills required to use resources effectively in the context of classroom learning, not as isolated library skills lessons. Resource-based learning programs can (1) provide for students' individual differences in learning rate and style; (2) maximize opportunities for exceptional students; and (3) familiarize students with the use of a wide range of learning materials, including modern technology (*Partners in Action*, 1981).

Mapping techniques are being applied to the task of matching resources in the media center collection with the curriculum (Loertscher, et al., 1986). Collection mapping is an evaluation technique that is designed to determine how a collection responds to units of instruction within the curriculum of a given school. The technique is currently being field tested in a number of schools throughout the country.

Another application of mapping techniques has been used for infusing information skills instruction with everyday curricular activities of the classroom (Eisenberg, 1984). Mapping techniques are used for implementing integrated instruction for gathering and evaluating information about the curriculum.

Computer software is available for integrating information skills into the curriculum. The software is designed to support individual course content objectives as well as to introduce and practice information literacy skills. One project applies information skills to language arts, mathematics, science, and social studies (Hoelscher, 1986).

Teachers should be trained to be information-conscious and to integrate the use of library media centers and information skills into the curriculum. The United Nations Educational, Scientific and Cultural Organization offers guidelines to show how teachers in both initial and continuing education should be trained (Hall, 1986). An outline of a possible course syllabus for the instruction of teachers and prospective teachers in the educational and curricular use of library media centers is provided, the methodology/structure of the course is discussed, and suggested implementation strategies are presented.

Adopting the goals of information literacy makes the library media center program reflective of the new information environment. The library media center takes on a more significant active role in the instructional goals of the school. Information literacy as a goal of the media center will encourage redefinition of its role in three ways (Shill, 1987). It enhances perceptions of the media center as an indispensable resource to provide access to information and knowledge in any format. By focusing on life-long information competency, the media center demonstrates the capacity to adapt to change. Finally, the media center gains visibility by proving its effectiveness and, as a result, commands a larger share of resources.

Using Information for Thinking and Learning

Recent results from the National Assessment of Educational Progress indicate some progress in students' development of basic or routine skills, but little in the development of higher-level thinking skills, such as problem-solving strategies or critical-thinking skills (*National Assessment*, 1985). The reason for this situation is that most school programs do not require students to think, to question, to weigh alternatives, to interpret inferences, or to identify propaganda devices (Smith, 1987).

Higher-level skills of comprehension, problem-solving, and communication are fast becoming basic skills in an information age. Inquiry encompasses many higher-order thinking skills. Sheingold (1987) characterizes inquiry as investigative problem solving. "Inquiry is a complex process that includes formulating a problem or question, searching through and/or collecting information to address the problem or question, making sense of that information, and developing an understanding of, point of view about, or 'answer' to the question" (p. 81). Inquiry is difficult to teach and to learn but the tools of technology open up new possibilities of making inquiry happen. Inquiry is an important goal of education. It spans the curriculum and is part of a person's real life outside of school.

An inquiry approach to research in schools involves the media specialist as a partner of the teacher in a cooperative team teaching effort. Seven elements of media center involvement in inquiry have been identified as networking, flexibility, cooperation, concentration, financing, community, and encouragement (Callison, 1986).

The following ten critical thinking skill competencies focus on areas school library media specialists have consistently identified as central to their instructional programs.

- Distinguishing between verifiable facts and value claims;
- Determining the reliability of a source;
- Determining the factual accuracy of a statement;
- Distinguishing relevant from irrelevant information, claims or reasons;
- Detecting bias;
- Identifying unstated assumptions;
- Identifying ambiguous or equivocal claims or arguments;
- Recognizing logical inconsistencies or fallacies in a line of reasoning;
- Distinguishing between warranted or unwarranted claims;
- Determining the strength of an argument. (Beyer, 1985)

This list might easily be adopted as the objectives of an information skills curriculum along with the knowledge of tools and resources.

Information skills are the tools for inquiry. Instead of trying to learn facts and concepts that will last throughout their lives students learn how to find information, discern what is important in a body of facts, and restructure information relevant to a given situation (Smith, J., 1987).

Four categories of thinking skills have been identified by the Association for Supervision and Curriculum Development as: (1) problem solving: to define or describe a problem, determine the desired outcome, select possible solutions, evaluate the outcome, and revise these steps where necessary; (2) decision making: to be able to select one of several options after consideration of facts or ideas, possible alternatives, probable consequences, and personal values; (3) critical thinking: to use basic thinking processes to analyze arguments and generate insight into particular meanings and interpretations; and (4) creative thinking: to produce along new and original lines (Costa, 1985).

Children can learn these skills at all levels of schooling. Bellanca (Costa, 1985) suggests that primary students be introduced to the following skills at a concrete level and middle-school and high-school students be involved at a more abstract level:

- observing
- comparing
- naming
- sequencing
- contrasting
- predicting
- patterning
- grouping
- goal setting

The media specialist plays a crucial part in preparing children for their role in an information-based decision-making society. Implementation of information skills programs has been assisted by the recommendation of teaching strategies and student activities for developing thinking (Hughes, 1986; Jay, 1986; Markle, 1987; Montgomery, 1987).

Online Databases

Several studies have been conducted on student use of online database searching. Craver (1985) describes how four classes of high-school students were introduced to concepts and terminology of online bibliographic searching, were instructed to formulate their own search strategies, and received the opportunity to observe their execution.

In another study, the microcomputer was used as a retrieval tool to link library skills with computer use (Herring, 1986). Secondary school students were helped to define a clear sense of purpose when selecting, evaluating, and organizing information. Findings indicated that information retrieval systems acted as a motivating influence in the initial stages of students' research assignments and students developed information retrieval skills when databases were used over a period of time and in a number of different contexts, especially when they were fully integrated with the students' assignments.

The most effective means of teaching online bibliographic searching is as a process similar to any other type of information searching. The stages of a search need to be made clear to students and a search strategy developed to retrieve relevant information from a database. A negative aspect of database searching in secondary schools is that media center collections do not hold many of the periodicals and other sources listed in the database. While this can be frustrating for students, it can also offer an opportunity for learning the larger network of information beyond the media center. There are negative as well as positive aspects of database searching of which the library media specialist must be fully aware to provide meaningful information skills instruction (Mancall, 1984).

Courses of study have been developed which offer guidelines for school library media specialists who are committed to teaching online searching. The objectives are to enable students to search and retrieve information from computerized bibliographic databases not only to access information necessary for their studies but also to acquire skills for lifelong learning. *Pennsylvania Online: A Curriculum Guide for School Library Media Centers* (1985) is planned to be integrated with other curriculum areas. The guide includes two sections: the first on course objectives, scope and sequence, and sample lesson plans, the second on management issues such as costs, vendors, and software.

Emerging Technologies

Online databases are not the only means of providing students with experience with database searching. CD-ROM (Compact Disc-Read Only Memory) is an emerging technology which has a range of materials available appropriate for student use (Vandergrift, et al., 1987a). Although student use

is uncommon at present and the cost is considerable, it may be the more appropriate database for the media center where online costs can become prohibitive and the immediacy of being online is not critical.

The electronic encyclopedia uses only 20% of the space available on one CD for the entire *Academic American Encyclopedia*. InfoTrac II combines magazine index coverage for the current year plus three years back, with several months of current indexing for the *New York Times*. The database is updated monthly. A recent study of high school students using InfoTrac II found that although it is a high-speed, quick-print device, it also allows students to browse and search related subject headings and subheadings (Vandergrift, et al., 1987b). Many students seemed to grasp a sense of the organization of information using InfoTrac II, and the ease of the search enabled students of all ability levels to locate magazine articles for assignments. Students could not access many of the articles because the school did not subscribe to every magazine indexed. However, there were so many alternatives that they could find something to satisfy them on most topics.

Indexes such as *Readers' Guide to Periodical Indexes*, which are commonly used in media centers, are available both online and on CD-ROM through H. W. Wilson. This technology offers the potential for acquainting students with the full range of journal literature available through indexes. The concept of indexing takes on a broader scope when presented through the indexes for the various disciplines, such as *Social Science Index* or *Art Index* rather than just through the single index of *Readers' Guide*. A study of high school students using *Wilsearch*, menu-driven software offering options to simplify search formulation, found that they had little difficulty using the software (Callison, 1986). Students were selective in the titles requested for printouts from *Wilsonline* and narrowed their choices even more when requesting interlibrary loan. They cited less than half of the articles and books they retrieved in the search. The critical information skills of evaluating and selecting information were applied in their search.

Computer/automated public access catalogs (PACs) are increasingly available in public and academic libraries. School library media specialists need to address the application of PACs in the media center (Smith, 1985). Networking with other libraries is enhanced with PACs, but communication with other PACs requires compatibility which is provided through use of the MARC tapes. Students need to acquire skill in using PACs. If the media center is to serve as an information laboratory for learning information skills, PACs need to be available within the media center.

MEANS OF ACHIEVING INFORMATION LITERACY

National Commission on Libraries and Information Science

The term "information literacy" was first used in a 1974 proposal to the National Commission on Libraries and Information Science (NCLIS), calling for a national program to achieve information literacy by 1984. The proposal characterized "information literates" as those who "have learned techniques and skills for utilizing the wide range of information tools as well as primary sources in molding information-solutions to their problems" (Zurkowski, 1974).

In January 1984 in response to *A Nation At Risk*, members of NCLIS stated that a basic objective of education is for each student to learn how to identify needed information, locate and organize it, and present it in a clear and persuasive manner. Mancall, Aaron, and Walker prepared a concept paper providing a framework of three principal components for teaching information finding and utilization skills to children and young adults (Mancall, et al., 1986, p. 18). Those components were:

- The role of school library media programs in helping students develop thinking skills.
- Theoretical implications of current research on how children and adolescents process information and ideas.
- Practical implications and applications of the concepts described in the first two parts of the paper as a basis for developing an educationally sound information skills program in all curricular areas.

The paper states: "When a process-oriented, integrated information management skills curriculum is in place and based in a physical facility with services that are capable of translating that curriculum into active teaching and learning, library media specialists will be successful in providing to students access to information and ideas in the broadest sense of the word" (p. 26).

An International Educational Issue

Information literacy is an international issue which many countries have addressed with support for research and programs. A United Nations information program developed guidelines designed to show how teachers in both initial and continuing education should be trained to be information-conscious and to integrate the use of school libraries and information skills in the curriculum (Hall, 1986). Three areas under which activities within teacher education could be organized are identified: (1) information skills and teachers' professional development; (2) information skills and the school

library; and (3) learning how to learn and the school library. Four case studies illustrate approaches being implemented within teacher education programs in Zimbabwe, England, the United States, and the South Pacific region.

The British Library Research and Development Department has given priority to research examining the nature of information skills and illuminating the problems of teaching and learning these skills. Priority has also been given to disseminating the results of this work, including any teaching materials arising from it, to as wide an audience as possible. The research reports on the following list are available through the British Library:

Educating Library Users in Secondary Schools, by Ann Irving and W. H. Snape, 1979.

The Need to Know—Teaching the Importance of Information, by Terry Brake, 1980.

The Schools Information Retrieval Project, by M. E. Rowbottom et al., 1983.

The Sixth Form and Libraries: Problems of Access to Knowledge, by Jean Rudduck and David Hopkins, 1984.

Knowledge, Information Skills and the Curriculum, by David Hopkins, 1987.

Learning Information Technology Skills, by Carolyn Carter and Jenny Monaco, 1987.

School Librarianship in the United Kingdom, by Helen Pain, 1987.

Educating Information Users in Schools, by Ann Irving, 1983.

The School Librarian's Day, by Ann Irving, 1986.

Collaborative Inquiry and Information Skills, by Jean Rudduck et al., 1987.

The Need to Know Project is an example of the action research approach taken in the British Library research effort ("British Library," 1978). Funded for one year, the project was designed to collect and organize materials relating to community information sources and to evaluate methods of teaching students how to retrieve and use such information in daily problems. The project was based on the assumption that many school children, especially those who do not go on to further education, are ill-equipped either to locate or to evaluate information.

Similar programs are being developed in other parts of the world. An example of another national effort is the Netherlands' project on Computer

and Information Literacy (Hartsuijker, 1986; Plomp, 1987). A national survey was conducted to determine how information literacy and computer literacy were being introduced in Dutch secondary schools, and programs have been developed for all students in lower secondary education, i.e., the 12- to 16-year-old age group.

Programs in the United States

Many states have responded to the call for information skills by directly involving the library media specialist and centering instruction around the library media program. A number of states have established requirements for instruction, standards for compliance, and/or recommended curricula.

In New York State, the Regent's Action Plan requires that library and information skills be taught in grades 7 and 8 in the equivalent of one period of instruction per week (*New York Regent's Action Plan*, 1985). The plan states that, "Library and information skills shall be taught by library media specialists and classroom teachers to ensure coordination and integration of library instruction with classroom instruction." Cooperative planning is an important component for implementing the plan, which further states, "Library media specialists, classroom teachers and administrators should cooperatively plan for implementation to meet the intent of the requirement and its time equivalency. A committee representative of the three groups above should be established to review the requirement, and its local implementation. The committee should consider all aspects of implementation and develop an overall plan that will provide student learning and be feasible for classroom and library programs" (p. 3).

A curriculum was developed in response to the Regents Action Plan which was designed to facilitate the coordination and integration of library and classroom instruction (*Information Skills Curriculum Project*, 1986). It is intended to be used as a guideline for teachers and library media specialists in developing their cooperative lesson plans. Included are 27 units for the content areas of art, English, foreign language, health, home and career skills, life science, mathematics, music, physical education, physical science, science/social studies/technology, social studies, and technology.

The Maryland State Board of Education passed a resolution stating that the unified School Library Media Program is essential to effective education for an information-based society. Components of a successful program were listed under the six categories of program, personnel, resources, facility, instruction, and resource services. Standards were developed which will be used in periodic review of local education agencies by the State Department of Education. The standards include direct instruction in retrieving and managing information, to be integrated into the educational program (*Standards for School Library Media Programs*, 1986).

Information Skills for South Dakota Students is a K-12 curriculum guide which includes goals for teaching library/information skills; a four-phase curriculum outline; a scope and sequence chart; and an extensive bibliography of instructional and professional materials (Gilliland, 1986).

Pennsylvania's online curriculum is particularly forward-looking with its initial course objective to explain the role of information in our society. There are 12 goal objectives in all. An easy-to-follow chart is provided with course objectives, content, resource materials, expected levels of achievement, and procedures for evaluation (*Pennsylvania Online*, 1985).

North Carolina's Department of Public Instruction has published a competency-based K-12 curriculum designed to ensure that each child acquires the skills necessary to become an independent learner and user of information resources. A set of clearly defined skills is presented, including those related to location, inquiry/investigation, and reporting (*Library/Media and Computer Skills*, 1985).

The American Federation of Information Processing Societies has prepared a detailed curriculum to teach information skills to secondary-school students ("Information and Computing," p. 160). The project offers guidance to school personnel who are beginning to plan a program of instruction. Program goals are to help students understand: (1) the impact of information and computer technology on today's society; (2) the importance of effective use of information both to the individual and to society; (3) how information is processed by humans, by computer and related technologies, and by human/computer systems; (4) how to obtain and use information for problem-solving and for decision-making; and (5) students' roles and responsibilities for living and working in an information age. The course outline covers the following areas:

- Information and Computing in Context.
- How Information Is Processed.
- Using Information.
- How Computing/Information Affects Us. ("Information and Computing," p. 160)

CONCLUSION

The information age requires of each of us a combination of technical skills and literacy abilities. Administrators, teachers, and library media specialists are joining forces to help students master information skills, thus enabling them to be competent information users in the future.

The implications of the findings cited here are obvious. Competent use of information can offer beneficial results to society-at-large; conversely, information illiteracy can cause real harm to individuals and to society.

Helping students gain information literacy also means helping students to learn to think. Learning to question, to weigh alternatives to interpret inferences, and to seek further data can only help individuals to cope with a continuously increasing wealth of information, and to survive in a world growing ever more complex.

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